



Laser Cutting and Etching Safety and Basic Use

COURSE # LAS101

Version 3.3

The Fine Print

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Colophon

These materials were created electronically using Microsoft Word®. Art was produced using Adobe Illustrator®, Adobe PhotoShop® and SnagIt® for screen captures. The Arial® family of typefaces is used throughout these materials. These materials were written by Laura Mappin and updated by Sebastian Bertsch and Dmitriy Kumets.

Course Synopsis

In this Safety and Basic Use class (SBU), you will learn how to safely use the Laser Cutter/Etcher/Engraver to cut a shape out of paperboard. What you learn about the process for this material can be applied to any other materials you may use in the Laser Cutter. You will also have an opportunity to raster text onto an anodized aluminum tag.

This class is taught in a highly interactive fashion. Your eager participation makes it easier for the instructor to tell if you understand the concepts and feel comfortable around this machine. Our goal is for you to come back and use the lasers confidently on your own. If you have any questions about anything pertaining to safety and basic usage, please ask.

Time Required: 2 Hours

Tools Required (most provided by TechShop)

- ☐ Epilog Laser Cutter
- ☐ Computer with CorelDraw or Adobe Illustrator
- ☐ Ruler (or tape measure)
- ☐ Note taking paper and pen/pencil (bring with you)

Materials Required for Class (provided by TechShop)

- ☐ Material to cut and etch/engrave

Materials to bring when you use the Laser Cutter as a TechShop Member

- ☐ Your Laser SBU notes
- ☐ Your material to cut or etch/engrave
- ☐ Notebook to record results/parameters for next time
- ☐ Ruler or tape measure
- ☐ Washers or quarters to weigh down light materials

SAFETY

General Safety

- ◇ Eye protection is required when working with anything that might get into your eyes, like metal shards, chemicals, sawdust
- ◇ Closed-toe shoes must be worn at all times
- ◇ Long sleeved shirts should be worn when working with chemicals, short sleeved shirts should be worn for anything with a rotary motor (saws, mills, lathes, etc.)
- ◇ Never leave a machine running and unattended

Shop Etiquette

- ◇ Never talk to anyone while they are working with a piece of equipment
- ◇ Leave the area you are working in cleaner than when you arrived
- ◇ Never leave a machine running and unattended
- ◇ Begin final clean-up and store your project no later than 11:30 pm

Equipment Specific Safety

- ◇ Laser Mantra –
 - ALWAYS WATCH YOUR WORK!
 - OPEN THE LID if you see a fire.
 - BLOW IT OUT if the fire keeps burning.
 - DON'T USE Auto Focus.
- ◇ You can cause great harm to yourself or burn the building down with these machines. If you follow the safety rules, the chance of you causing this should be close to zero
- ◇ These lasers affect your material by heating it. Your job can change in seconds with the accumulation of energy – HEAT – in your material. ALWAYS MONITOR YOUR LASING JOB! NEVER leave the room while your job is running.
- ◇ Some materials, like wood, are burned in order to achieve an etch or cut. Some materials, like acrylic, change their chemical structure. In all cases, some light may be visible. This light at the point of lasing may be ok as long as it stays with the motion of the laser. If a flame appears while the laser is in operation, stop your job and try again with lower heat settings.
- ◇ Each TechShop laser cutter is a finely calibrated piece of machinery. Please close the lids quietly and do not push or jar the machines at any time. Do not lean on or press on the tray. BE SURE the edge guards are in the down position before operating.

Fire Safety

Always watch your work, no matter how long your job takes. The danger of fire is ever present. If you need to leave, you **MUST** pause the job using the **Stop** button.

Remember: You could be in this room while someone else is carelessly lasing and have to deal with their fire. Do not put yourself or your fellow TechShop members in that situation. If you see that someone else has left their running laser job, then for the safety of everyone in the building, stop the laser and bring it to the attention of TechShop staff.

You should always expect that your material could present you with a few birthday candles' worth of flame at any time and you need to be prepared for that. Your material can also heat up or move or change state in ways you cannot predict.

Small fire

- ◇ If you see a small fire or more than one flash flame in 15 seconds, you must:
 - Open the lid
 - This may be enough to put the fire out. If not -
 - Blow it out

Larger fire

- ◇ If you see a slightly larger fire still contained within the laser but such that opening the lid may burn you, do the following:
 - Alert TechShop staff
 - Pull the fire alarm or use your voice to alert people
 - Apply the fire extinguisher to the front grill air intake
 - Turn the machine off

Even larger fires

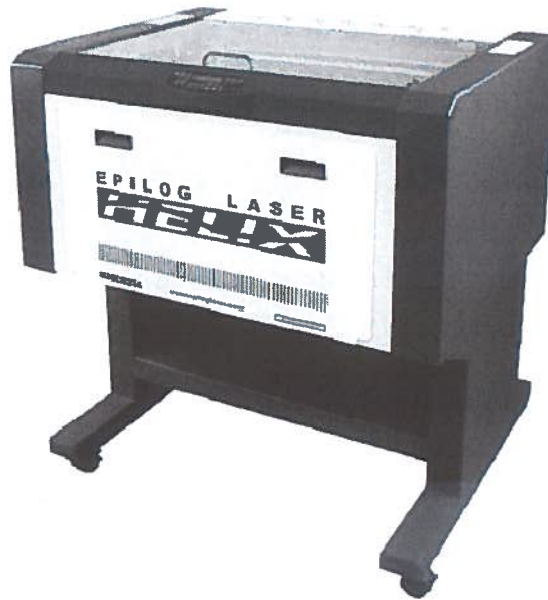
- ◇ Alert TechShop staff
- ◇ Pull the fire alarm or use your voice to alert people
- ◇ Evacuate everyone from the laser room and close the door
- ◇ Call 911
- ◇ Evacuate the building

Use wise judgment and common sense when responding to a fire. Remember to get help and don't be a hero.

Epilog CO₂ Laser

A laser cutter is used to etch, engrave, or cut a variety of materials. Be sure to see the approved and unapproved lists of materials for the laser cutter before purchasing or working with the material in the laser cutter.

At TechShop we have 45 watt and 60 watt Epilog CO₂ lasers with 24" x 18" tables. The wattage of your laser is marked on the front of the machine.



Raster vs. Vector

The laser is a printer that prints with heat. It first prints all your raster data, similar to an ink jet printer that prints with ink, putting down "dots of heat" instead of ink. It then moves like a plotter and follows your vector paths to draw or carve them into your material.

Raster data is made of pixels. File types of jpg, gif, png, and bmp are all examples of raster data. Images that come from your camera or scanner are also raster data. The laser varies the amount of heat delivered for each pixel, resulting in what looks like a photo burned into your material.

Vector data is expressed via equations. Straight lines, circles, rectangles, splines, hand drawn squiggly curves are all examples of vector data.

The above is true from the perspective of software applications that handle vector and raster data. The laser treats the data slightly differently.

For the laser, all data is treated as raster data except for vector data that also has a line thickness of hairline - .25. Hairline is the smallest non-zero value possible for vectors in CorelDraw. If you develop your artwork in another application, choose the smallest non-zero thickness available and your data will typically import into CorelDraw as hairline thickness. In CorelDraw, some line thicknesses ($\leq .003$ pt) are also treated as hairline.

Just because you're using vector data doesn't mean you must cut through. You can score cardboard to mark the fold lines to make it into a box. Conversely, just because you're using raster data doesn't mean you can't etch through. You will see examples of this in class.

Each method has the capacity to produce a fire. Always watch your work!

Turning off the Laser Beam

There are two ways to stop the machine – one for convenience and one for emergency.

1. Press the Stop button
 - WAIT for the machine to stop before you leave it
 - This method does not stop the laser immediately.
 - Use this method for convenience when you have to leave the room and want to just pause your job.
2. Lift the Lid
 - Use this method if there is a fire. This immediately turns off the laser beam but it does not stop the motion of the X/Y table.

Note: Make sure the exhaust fan is ON. The fan should always be ON. Do not turn the fan OFF.

Each laser cutter is connected to an exhaust fan system to remove toxic fumes. For your safety, always make sure the fan is running when operating the laser cutter. It has a separate on/off switch from the laser machines and must be turned on independently. One switch may run the exhaust for all lasers in your area.

The Epilog Laser cutter is controlled by software and is installed as a printing device.

This is the front panel of the laser cutter:



NOTE: The front panel of some lasers may appear different, as button placement varies between models. The function of the labeled buttons remains consistent.

The **Reset** button is your general button to get out of other modes of operation and move the machine back to its basic power up state. It will move the head back to the current home position, which is the “native home” (top left corner) of the machine unless you have set a new home somewhere else. The reset button also deletes one job from the top of the queue, helpful if you prematurely sent a job and need to prevent it from printing.

The **Go** button starts to print a job. Go will also continue a job that has been paused using the Stop button. Go is also your button to press to answer affirmative to a question on the panel.

Stop is a pause button; it stops the job at the end of the current vector or raster line. Pressing the **Go** button will continue the job exactly where it left off. Stop is also your button to press to answer negative to a question on the panel.

X/Y Off tells the machine to let go of its hold on the X/Y axes and give control to you to move the print head manually. It requires confirmation by following up with pressing the **Go** button.

The **Focus** button moves you into focus mode, which allows the Up and Down buttons to work. Pressing **Reset** gets you out of focus mode and ready to accept a job.

The **Up** and **Down** arrows move the bed up and down to set the focus. They are not accessible when you are not in Focus mode.

The **Pointer** toggles on/off the red pointer light. This pointer can be turned on and off independently at any time while a job is running and it will not affect the job.

Clean-Up

The user before you had to do the following, which explains why the machine and the room are in the state they are for you. See next section for detailed instructions on each step.

- Leave the laser tray in the machine, with the focus gauge stored on the magnetic strip atop the machine
- Vacuum up debris from metal bay to remove this fire hazard
- Empty the catch tray below the laser tray of any debris
- Check the lens; if dirty, let front desk staff know
- Turn the laser off and carefully move the print head to the top right corner of the print area
- Leave exhaust fan on

In some TechShop locations the shut down procedure is as follows. Check with the staff at your TechShop for the laser policy.

- Carefully remove table from laser and place in bag to return to front desk
- Remove focus gauge, place in bag, and return to front desk
- Vacuum up debris from metal bay to remove this fire hazard
- Check the lens; if dirty, let front desk staff know
- Leave laser on, open, in focus mode
- Leave exhaust fan on

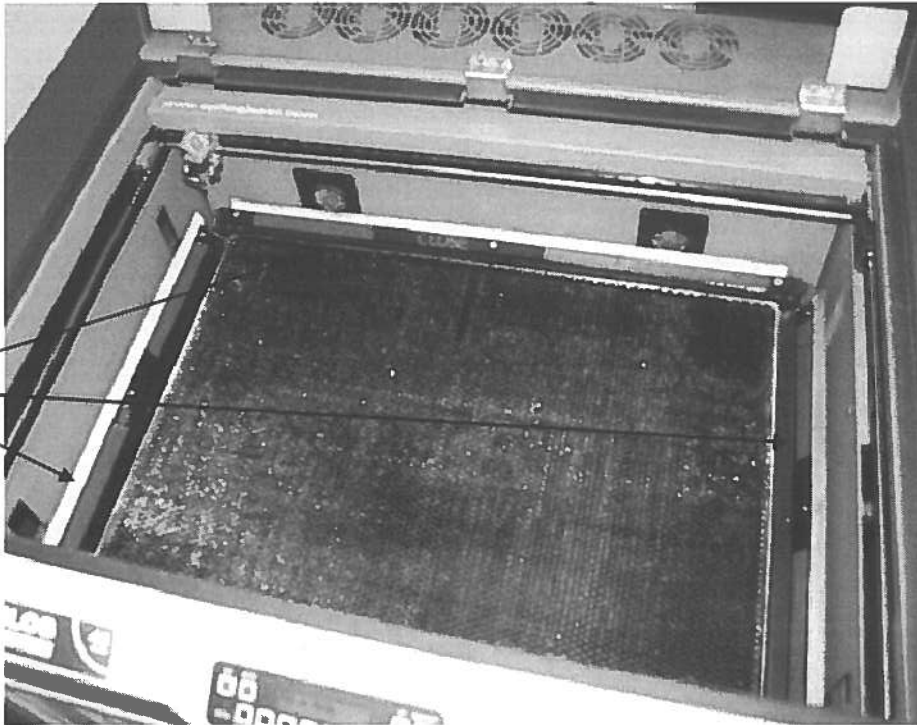
Set-Up

Be careful when moving parts and material around in the laser. The laser is a finely calibrated machine. Bumping parts can knock it out of alignment for you and everyone after you resulting in less precise cuts and etches and possibly ruined projects.

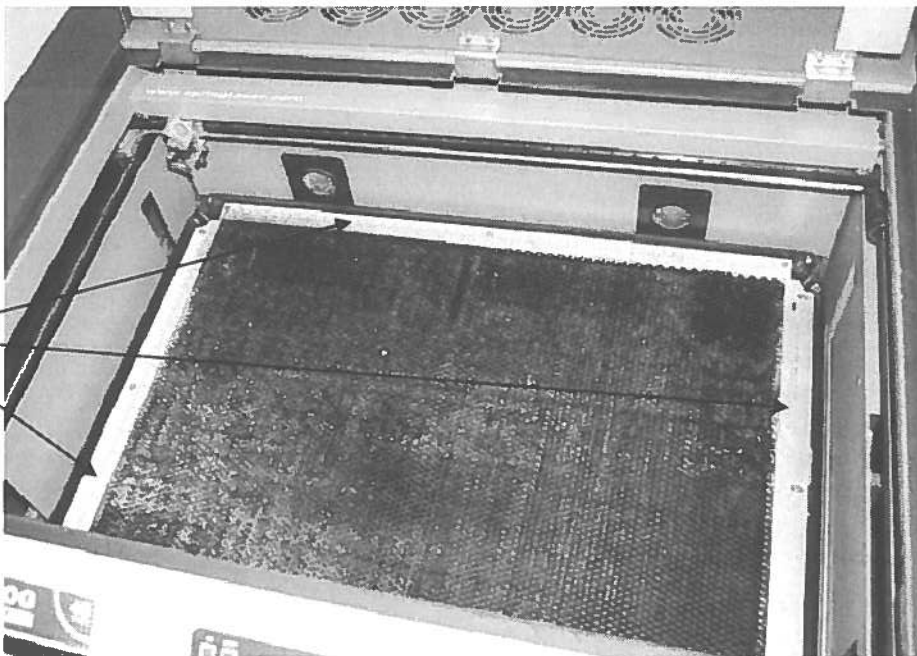
1. Always ensure you start with a clean machine.
2. Take the tray from the bag or under the machine (if it had been removed) and insert into laser. Be sure to flip the three straight edges down after inserting the tray.
3. Push on the black back on the edge guards to flip them up to insert or remove the tray (this is FAR easier than trying to lift them by the front edge). Don't forget to flip all 3 guards back down once the tray is in place.
4. The bottom of the tray has a thin strip of aluminum around the outside edge; the tray goes in with these facing down.
5. Put the tray in, back edge first. If necessary, push back and down gently so it sits properly and avoids hitting the focus head. Don't forget to flip all 3 guards back down once the tray is in place. The tray should sit flat; with the edge guards flush on the tray surface.

NOTE: The red tape tells you that the edge guards are still up in Menlo Park only! The tray stays in the machine at all other locations and the edge guards will rarely ever be showing.

RED tape
means the
edge guards
are UP!



NO red tape
means the
edge guards
are DOWN,
as desired!

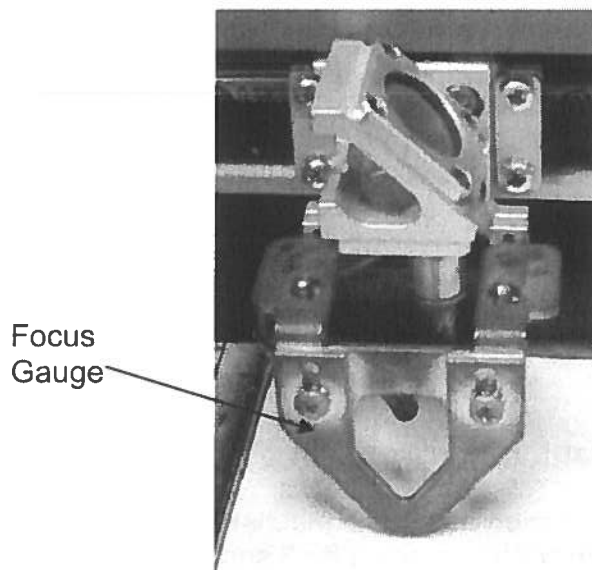


6. Place the focus gauge on top of the machine. Do not hang it on the optics, the additional weight of the gauge can cause motor problems.
7. Check the lens for cleanliness
 - a. If dirty, ask front desk staff to have it cleaned

- b. Do not touch the lens or mirror. Hold below the optics or atop the print head, careful not to touch the back of the mirror (gray circle)
8. Place your material on laser table
9. Focus laser onto top surface of your material

Perform these steps in the following order to ensure that you DO NOT bump the lens assembly with your material or with the laser table:

1. Make sure the focus gauge is in its rest position atop the machine. Ensure there is nothing in the way of the print head, particularly your material.
2. Choose Focus mode by pushing the Focus button on the front panel. This moves the X/Y table sideways into the print bed slightly.
3. Press the Down arrow button on the front panel to move the table down more than enough to accommodate the thickness of your material.
4. Place the focus gauge on top of the magnetic plate (near the front of lens assembly) so that the tip hangs straight down. The focus gauge is magnetically held onto the top of the lens assembly.
5. Place your material under the focus gauge.



6. While in Focus Mode, press the Up Arrow button and CAREFULLY move the bed up, being sure not to run into the lens assembly. When the table gets close to the focus gauge, move in small increments.
7. Never move the table up without the focus gauge in place. It is possible to run the table off its rails.

8. BE SURE to move the focus gauge back to its storage place atop the machine after you have set the focus.
9. Press Reset to get out of Focus Mode.

Setting the Home Position

The Default Home Position

The default Home position is the upper left corner of the table where the two straight edges meet. To see this point, turn on the pointer and press the Reset button. You will see the red dot move to the upper left point where the straight edges meet.

Note: You will see the dot move to the top left corner, then move down and to the right slightly. When in native home, the machine rest slightly off of the back left corner to reduce strain on the drive belts.

This point is almost always set up to correspond to the upper left corner of your file – your (0,yMax) coordinate, not (0,0)

Setting Home to a Different Location

Use this method when you have material that cannot be placed square with the straight edges or you are trying to precisely place artwork on a material.

1. Press the X/Y Off button on the front panel of the Laser.
2. Press the Go button on the front panel of the Laser.
3. Use one finger to move carriage. If the carriage or print head doesn't move easily, SOMETHING IS WRONG. Check the panel for a message.
4. Turn the pointer on to see where the laser will be.
5. Move the carriage and lens to the desired location. DO NOT TOUCH OPTICS!
6. Press the Set Home button on the front panel of the Laser.
This establishes a new home position that matches with the upper left corner of your file.

Setting Home Back to the Default Home Position

1. Power cycle (turn it off and then on again) the machine with the main power switch on the left of the machine - Turn the machine off for 3 seconds, and then turn it back on.

Note: Make sure the tray is free of objects that could be struck by the print head as it moves in its warm up phase.

As a finer point to the overall TechShop rules, to send jobs to the lasers, you must use the PCs next to each laser. You may not use your own laptop or any other PCs. This is a safety issue to ensure that the job sent to the laser is the one expected by the person physically loading the

laser. Use a USB drive to transfer your work from your design computer to the laser cutter computer.

Design work is not permitted at the laser computers. These computers are provided for running laser jobs. Either work on your own personal computer, or use one of the computers in the computer lab or the hub.

Cleanliness of the Optics

Dirty optics can cause poor etch and cut quality, increased risk of fire from laser diffusion and even crack the optics from heat accumulation. The laser optics need to be cleaned multiple times a day, particularly if dirty materials are being lased, such as leather, fur or certain woods.

An easy way to diagnose dirty optics is visually. If you see specks on either mirror (on the print head, or on the left side of the carriage) then they may need to be cleaned. To inspect the lens on the print head, turn the red pointer on. If you see a red circle on the lens, then the lens has dirt on it. Get a staff member to clean it for you, which will only take a few minutes and will ensure better quality cutting and etching on the laser cutter. DO NOT attempt to clean the laser yourself; you could permanently damage the optics.

Materials Safety

Start with clean material on the Approved Materials List. Avoid any toxic or flammable coatings on your materials.

Laser Approved Materials List

MATERIAL	ENGRAVE/ETCH	CUT
Wood	YES	YES
Wood Veneer	YES	YES
Acrylic	YES	YES
Delrin (hard plastic)	YES	Only if it's thin enough
Melamine	YES	YES
Mylar Plastic	YES	YES
Corian	YES	YES
Rubber (some)	YES	YES
Glass	YES	NO - cannot cut glass
Ceramic (some)	YES	NO - cannot cut ceramic
Tile (some)	YES	NO - cannot cut glass
Marble	YES	NO - cannot cut marble
Coated Metals (some)	YES	NO - cannot cut metals
Anodized Aluminum	YES	NO - cannot cut metals
Painted Metals (some)	YES	NO - cannot cut metals
Cloth of natural fibers	YES	YES
Leather	YES	YES
Matte Board	YES	YES
Paper	YES	YES
Pressboard	YES	YES
Cork	YES	YES
Chocolate	YES	NO - it just melts onto the metal bed
Pumpkin	YES	NO - too much water in pumpkin to be effective
Swiss Chard	YES	NO - too much water in swiss chard to be effective
Potato	YES	NO - too much water in potato to be effective
Tortilla	YES – the drier the better	YES – the drier the better

Laser Unapproved Materials

PVC	Contains chlorine, will produce hydrogen chloride gas and can harm your body and the machine's optics!
Vinyl	Most contain chlorine, will produce hydrogen chloride gas and can harm your body and the machine's optics!
PVC Foams	Contains chlorine, will produce hydrogen chloride gas and can harm your body and the machine's optics!
Foam Core	Modern foam core is usually made of PVC, so it contains chlorine, will produce hydrogen chloride gas; it also risks a flash fire
Styrofoam	Can flash fire
Polycarbonate or PETG	Does not cut. TAP Plastics sells both polycarbonate and acrylic. Be Careful! Read your label. Lexan is a trade name for polycarbonate. Plexiglas is a trade name for acrylic.
ABS	Gives off hydrogen cyanide
polymer clay	Contains PVC.
Fiberglass	Get approval from TechShop staff
Metals	Cannot be etched by this laser AND risk reflecting the laser beam back up into the laser. Some metals may change appearance but not predictable enough to usually be usable as an engraving. If someone claims they are etching metals on these lasers, they are etching a metal with a plastic coating or anodized surface or other etchable covering.

Many of these unapproved materials off gas poisonous gases that can kill you and others in the Laser room

- a. HCl – hydrogen chloride
- b. HFI – hydrogen fluoride
- c. HCN – hydrogen cyanide

Materials that are not on either list

1. Get approval from TechShop staff person
2. Increase your chances of getting this approval
 - a. Buying from a reputable source
 - b. Having the corresponding MSDS with you

Do not lase anything that is not on the Approved Materials List or has not been permitted by TechShop staff.

TechShop has many other ways to manipulate non-laserable materials. Consider the CNC mills, saws, maybe even the plasma cutter. Ask TechShop staff for more ideas.

Do not use auto focus, DO NOT USE AUTO FOCUS, **DO NOT USE AUTO FOCUS!!!** It can fail and then the machine is unusable for hours or days until external support fixes it.

Cutting and Etching

For this class, you will be given paperboard, and you will send artwork to the laser cutter to cut and etch on the paperboard. Each person will take a turn to improve the previous person's job. In this way, you will see a number of ways to mark your material. You can then apply these techniques to your own materials.

If you have **ANY** questions about any operation or task, be sure to ask your instructor or another TechShop staff member before proceeding.

1. Draw a small circle and put some text in it in CorelDraw
2. Set up the first job with draft parameters:
 - a. Draft DPI
 - b. Choose Combined (both Raster and Vector)
 - c. Set and note Raster Speed
 - d. Set and note Raster Power
 - e. Set and note Vector Speed
 - f. Set and note Vector Power
 - g. Frequency – follow the chart
 - h. Auto focus – DO NOT USE!!

Take the Laser Advanced Class to learn more about these and other parameters.

When using the Speed and Power Recommendations, it is best to start at the low end of the heat spectrum, with high speed and low power. You are less likely to have a fire situation, and it causes much less duty cycle on the laser tube, which will ultimately cause the laser to run better for longer.

Slower speed increases heat. Think of the candle analogy. If you slowly pass your hand across the flame, your hand will receive more heat than if you pass it across more quickly.

3. Send and run job
 - a. The Laser is ready to receive a job if it says Job: on the panel. Press the Reset button if needed.
 - b. Send job to printer – user must press the Go button to run job.
4. Experiment improving parameters and running job
 - a. Adjust the DPI first.

DPI affects the heat delivered to raster art. You can cause a fire JUST BY increasing your dpi for raster art. Try different DPI settings until you have the resolution you want.

Adjusting Power and Speed Setting

Start at low heat settings; increase power in small increments per trial. If you reach 90% power and still don't have the effects you want, decrease the speed in small increments per trial run.

Raster Speed Rule

In raster mode the print head moves rapidly side to side, printing your artwork quickly horizontally as it moves down slowly. If your artwork is small, a high raster speed will bounce the print head side to side with such acceleration that the motors may be damaged. For raster there are maximum speed limits based on artwork size. Remember, this is referring to the size of your smallest raster artwork, not the size of your piece or average raster artwork size.

Raster Speed Limit

0"-6"	6"-10"	10"-16"	16"-24"
60% speed	70% speed	80% speed	100% speed

PROJECT DESCRIPTION

For this project, each student will need one anodized aluminum key tag, provided in class and available from the Retail Store in TechShop. You will also need the Key Tag jig that is available for checkout from the Front Desk.

If you have **ANY** questions about any operation or task, be sure to ask your instructor or another TechShop staff member before proceeding.

Preparing for this project

For this project after class, you may change the text in the file provided but in the interests of time, please do not change the font or incorporate graphics. For future key tag projects, you may want to spend some time on one of the Hub Computers, designing your graphic or text. Locate and open the CorelDraw file named TAG_Names.cdr

Use your USB drive to take your finished work to the Laser Cutter (don't forget to reserve time via the front desk, the laser cutters are in very high demand).

- a. Prepare the computer.

The computer is normally on and should be left on. Make sure the monitor is also on.

- b. Turn on the laser cutter.

The On/Off switch for the laser cutters is on the left side of the machine.

- c. Make sure the exhaust fan is running

If it is not running, turn it on. This exhaust fan is external to the laser. Both the laser and the exhaust fan must be on before running your job.

- d. Check the lens

A dirty lens can affect your power settings significantly and can also be a source of fire. If dirty, alert TechShop staff so they may clean it.

- e. Check the metal bay for debris

NOTE: Don't forget to lower the **3 edge guards** after placing the tray.

- f. Place the anodized key tags in the jig provided at the upper left corner of the grid.
BE SURE to use only approved materials

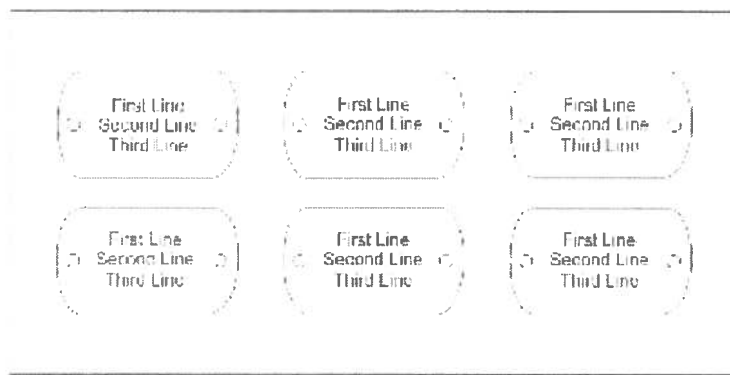
- g. Set the focus manually

Getting Started

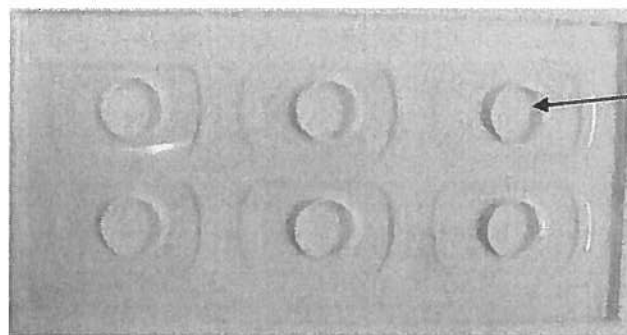
1. Check out the Key Tag Jig from the Front Desk if it hasn't been provided for you.
2. Open the file TAG_Names.cdr and enter the text you want to engrave on your 6 tags.

NOTE: If you want to print less than 6 tags at once, BE SURE to delete the other text blocks so they don't engrave on the jig.

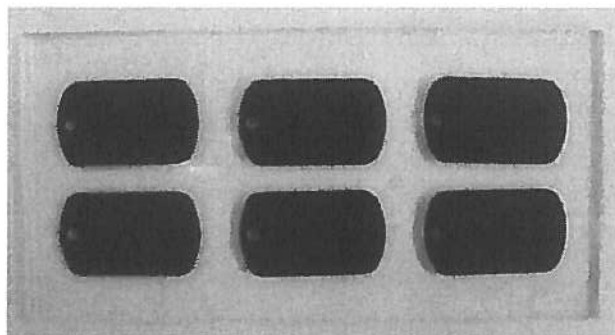
Each tag has room for up to 3 lines of text. Be sure to check all of your text before printing to the Laser Cutter. Make sure it fits within the keytag vector shapes in the file.



3. Place the tags in the jig. Place the jig in the upper left corner of the bed.



Empty jig with
"finger holes"
to remove tags



4. From the File Menu, choose Print. The Print window will appear.
5. Click the Properties button on the Print window.

The tags are anodized aluminum, so, you should set the Resolution to your desired output (300DPI, etc), the Job Type to Raster, and the Raster Speed and Power using the recommended settings on the settings chart as a starting point.

6. The Piece Size is 8 x 4, which is the size overall of the jig. Be sure to set this as the job size in your settings page or else the laser will print your file in the middle of the table.
7. Click OK to accept the new Properties you have just set.
8. Click Print to print this job.

Note: When laser etching anodized aluminum, the goal is to remove the colored dye from the anodized layer. Increase your settings until the laser leaves a white engraved mark, with a hint of the original color. If the laser leaves a silver surface then your settings are too high and you are burning away the anodization, exposing bare metal.

1. Attach your USB thumb drive to the computer.
2. Launch CorelDraw on the computer. This resets all parameters to their default settings.
3. Load your file - From the File menu, choose Open, locate your USB thumb drive and select your file. Click Open.

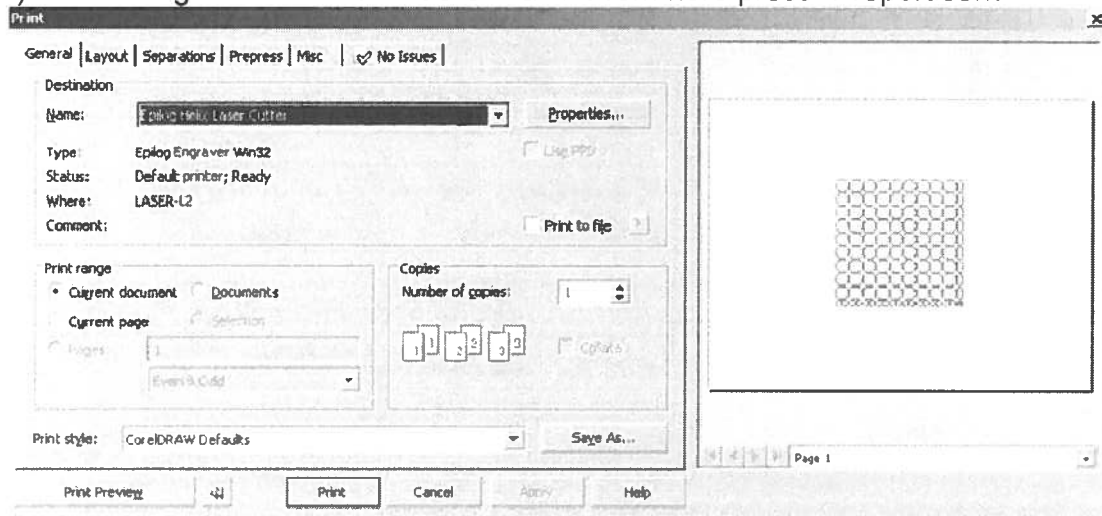
Some common file formats for raster data are .JPG, .GIF, .PNG

Some common file formats for both raster and vector data are .DXF, .DWG, .EPS, .PDF, .SVG

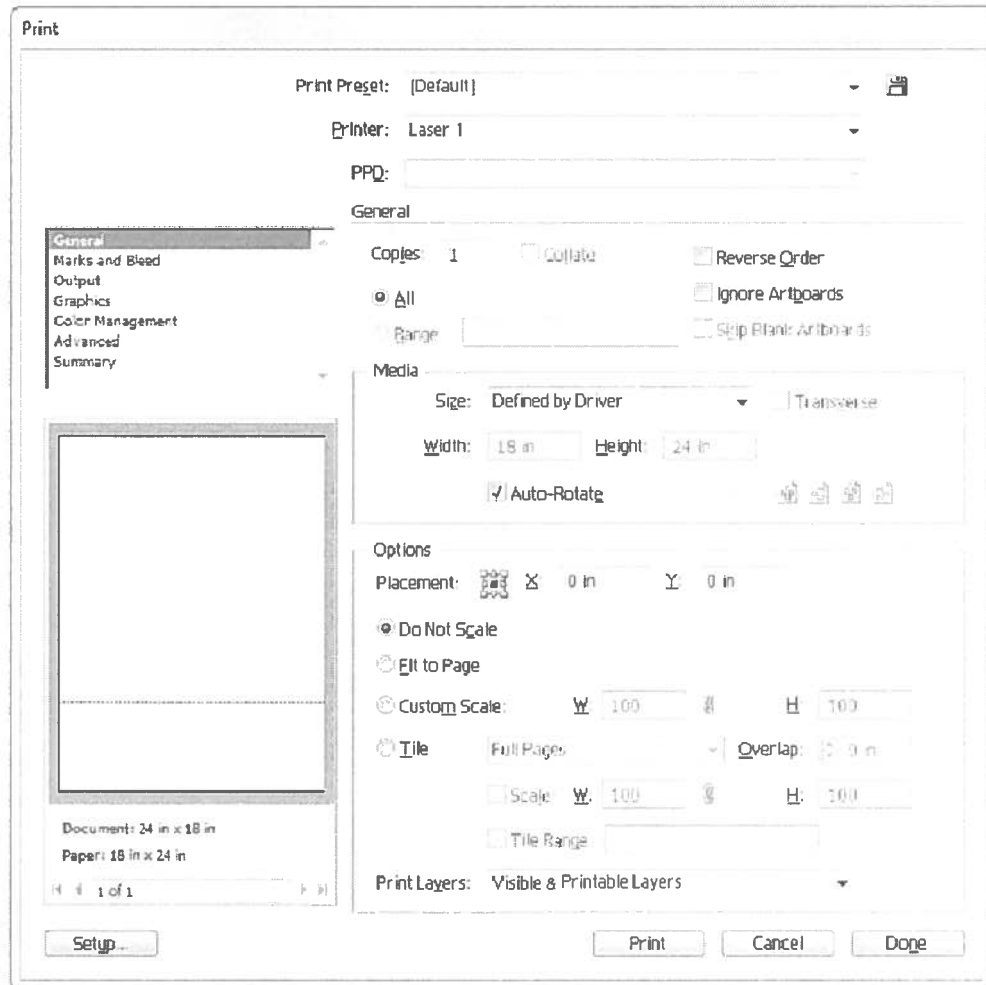
Setting the Parameters

1. From the File menu, choose Print. The laser will show up as the default printer.

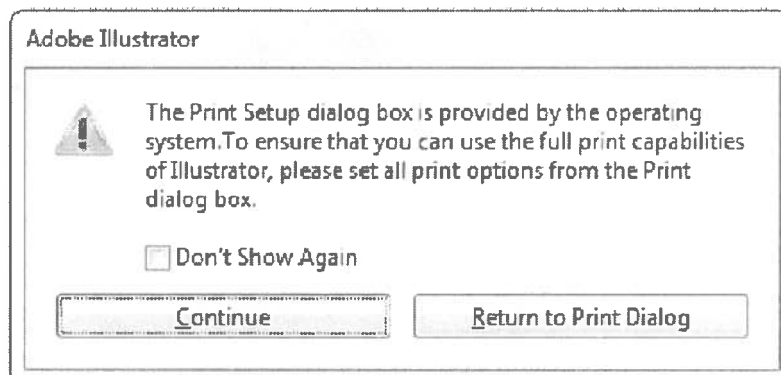
i) Print dialog box from within CorelDraw. From here press "Properties..."



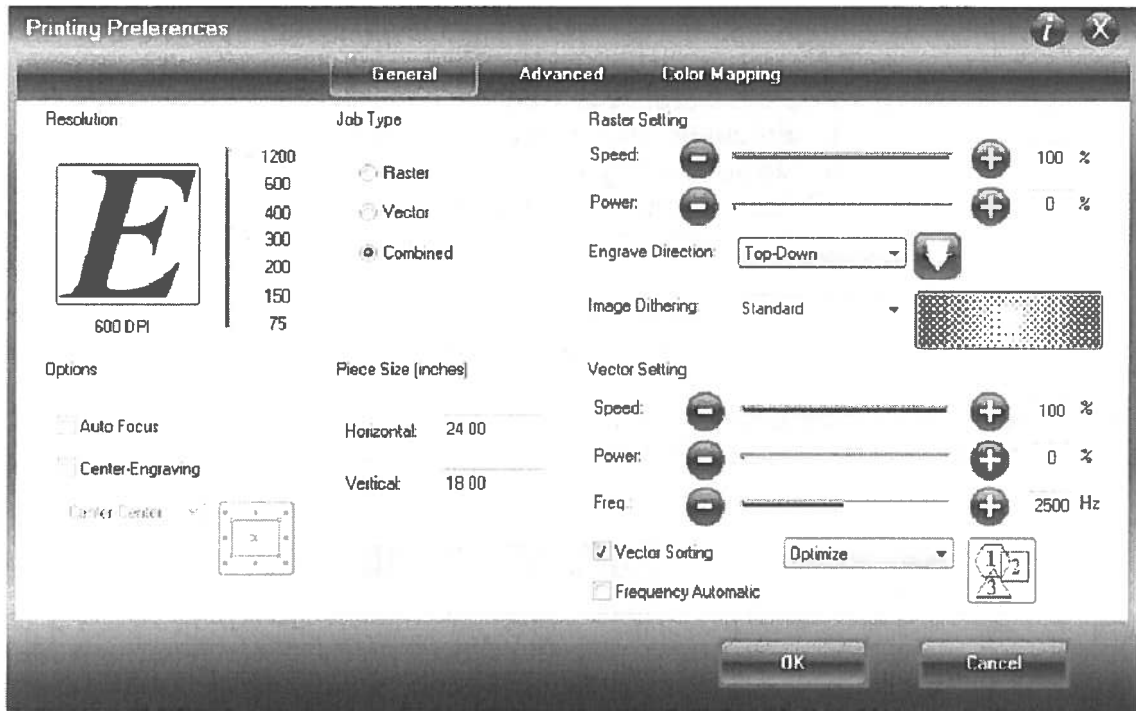
ii) Print dialog box from within Adobe Illustrator. From here press “Setup...”



iii) Illustrator will open a second, smaller window. From here press “Continue”.



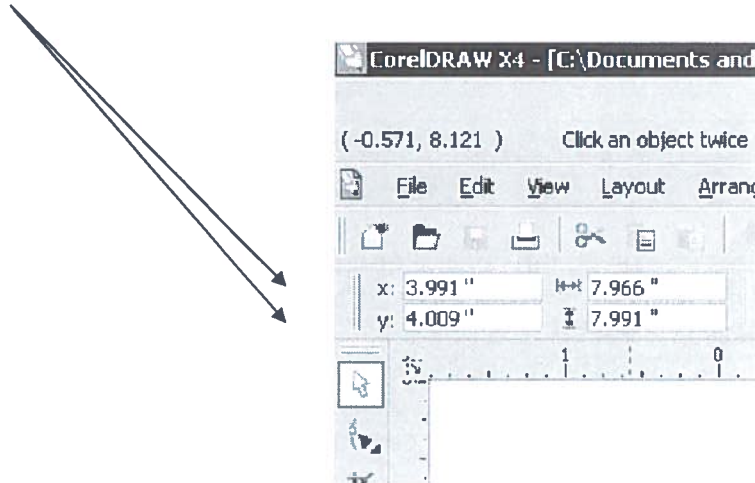
2. Click the Properties button. The Properties window will appear:



3. Set the following for this job, using the chart on page 12 as starting place:
 1. DPI (dots per inch) – affects both raster and vector art.
 2. Raster / Vector / Combined
 - a. To lase just raster work, choose Raster.
 - b. To lase just vector work, choose Vector.
 - c. To lase both raster and vector work in the same job, choose combined.
 3. Raster Speed
 - a. Refer to the settings chart in this handout or posted in the Laser Room to identify the starting speed for the material you are working with.
 4. Raster Power
 - a. To see where your job will be lased without actually lasing it, set Power to 0.
 - b. Refer to the setting chart in this handout or posted in the Laser Room to identify the starting power for the material you are working with.
 5. Vector Speed
 - a. Refer to the settings chart in this handout or posted in the Laser Room to identify the starting speed for the material you are working with.
 6. Vector Power

- a. To see where your job will be lasered without actually lasering it, choose Power of 0.
 - b. Refer to the settings chart in this handout or posted in the Laser Room to identify the starting power for the material you are working with.
7. For frequency refer to the guidelines in parameter charts.
 8. Frequency Automatic should **not** be checked.
 9. Vector Sorting should be checked.
 10. Auto Focus should **NEVER** be checked.
 11. Piece size should be set to your document dimensions:
 - a. To change the size of your document, at the top of the screen type in the vertical and horizontal dimensions and make sure to press Enter to set the new dimensions.

HINT: If you are in your document with no objects selected, the x and y size of it will be displayed on the top line of CorelDRAW. Type these numbers in for the Horizontal and Vertical Piece Size:



Vector parameters will be applied to every object in your data file that has the attribute of "Hairline". Remember – just because you might think of it as vector, if it does not have the attribute of "Hairline", it will not be cut; it will be etched instead.

Raster parameters will be applied to everything else. Think of Raster as a photo or GIF, JPG, BMP – pixel-based. Raster will account for gray-scale or colors. Lighter colors and lighter gray scale will receive less laser energy.

Consult the documentation posted on the wall in the Laser Room or this handout to determine what speed and power settings might work for your material. Remember, these are just a starting place, you will need to experiment.

IMPORTANT NOTE: Some experimentation will be required to get the desired result. Start at a lower energy level and work up to find your sweet spot.

Always bring extra scrap material with you that is identical in quality to what you want to finally laser. Use this scrap to test and verify that the machine and your material are behaving as you expect. Use a small piece of artwork to quickly test different settings.

1. Print the job
 - a. Click the Print button on the Print screen.
 - b. Wait for the green Data light on the laser's front panel to go off. Your job is now downloaded to the Laser Cutter.
 - c. Push the Go button to start cutting.
 - d. Watch your job as it is lased. Ensure that everything is going correctly.
2. Checklist
 - a. Focus – did you move the surface of your material into the plane of the laser?
 - b. Lens – did you check to see if the lens is dirty? If it is dirty, ask a staff person to clean it.
 - c. Exhaust fan – is the exhaust fan on?
 - d. Parameters – are your vector and raster speed and power parameters set appropriately for your material and the job you're trying to accomplish?
 - e. Parameters – are your parameters set for the machine you're using? Are you using 60-watt parameters on the 45-watt machine? Are you using parameters from one machine on another of the same wattage? They are not guaranteed to work that way. If you're on the same machine as before, have you tested your parameters to make sure they still work as before?
3. Parameter Setting Recommendations

The following tables provide parameter recommendations for materials in Epilog 45 watt and 60 watt CO₂ Lasers at TechShop:

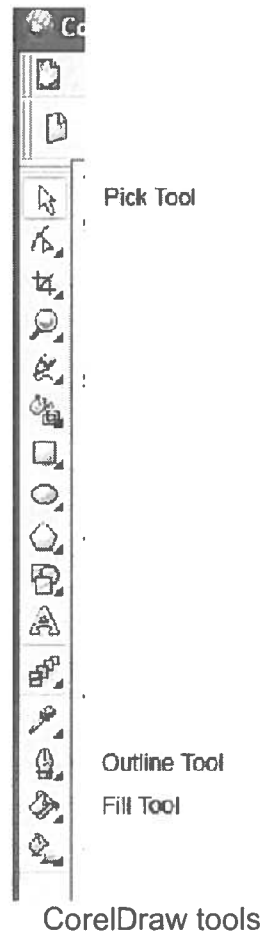
45-Watt LASER CUTTER Speed and Power Recommendations

Material	300 DPI RASTER ENGRAVING	400 DPI RASTER ENGRAVING	600 DPI RASTER ENGRAVING	VECTOR CUTTING
	SPEED/POWER	SPEED/POWER	SPEED/POWER	SPEED/POWER/FREQUENCY
Wood - Cherry - Alder - Walnut	25/90	35/90	45/90	1/8" (3mm) - 35/90/500 1/4" (6.4mm) - 10/90/500 3/8" (9.5mm) - 4/90/500 (two passes may produce better results)
Acrylic	100/55	100/45	100/35	1/8" (3mm) - 15/90/5000 1/4" (6.4mm) - 6/90/5000 3/8" (9.5mm) - 3/90/5000 (two passes may produce better results)
Anodized Aluminum	100/90	100/80	100/70	N/A
Brass - Painted	100/55	100/45	100/35	N/A
Marbelized Painted Brass	100/65	100/55	100/45	N/A
Corian or Avonite	25/90	30/90	35/90	1/8" (3mm) - 30/90/5000
Delrin Seals	100/60	100/50	100/40	70/90/1000
Glass	25/90	35/90	45/90	N/A
Laserable Plastic	100/65	100/50	100/40	30/75/500
Leather	100/55	100/45	100/35	1/8" (3mm) - 40/50/500
Marble	20/90	25/90	30/90	N/A
Mat Board	100/65	100/45	100/30	50/50/500
Melamin	50/90	60/90	70/90	N/A
Stainless Steel W/ Cerdec Coating	20/90	25/90	30/90	N/A
Natural Rubber and Rubber Stamps	20/90	30/90	40/90	20/90/100

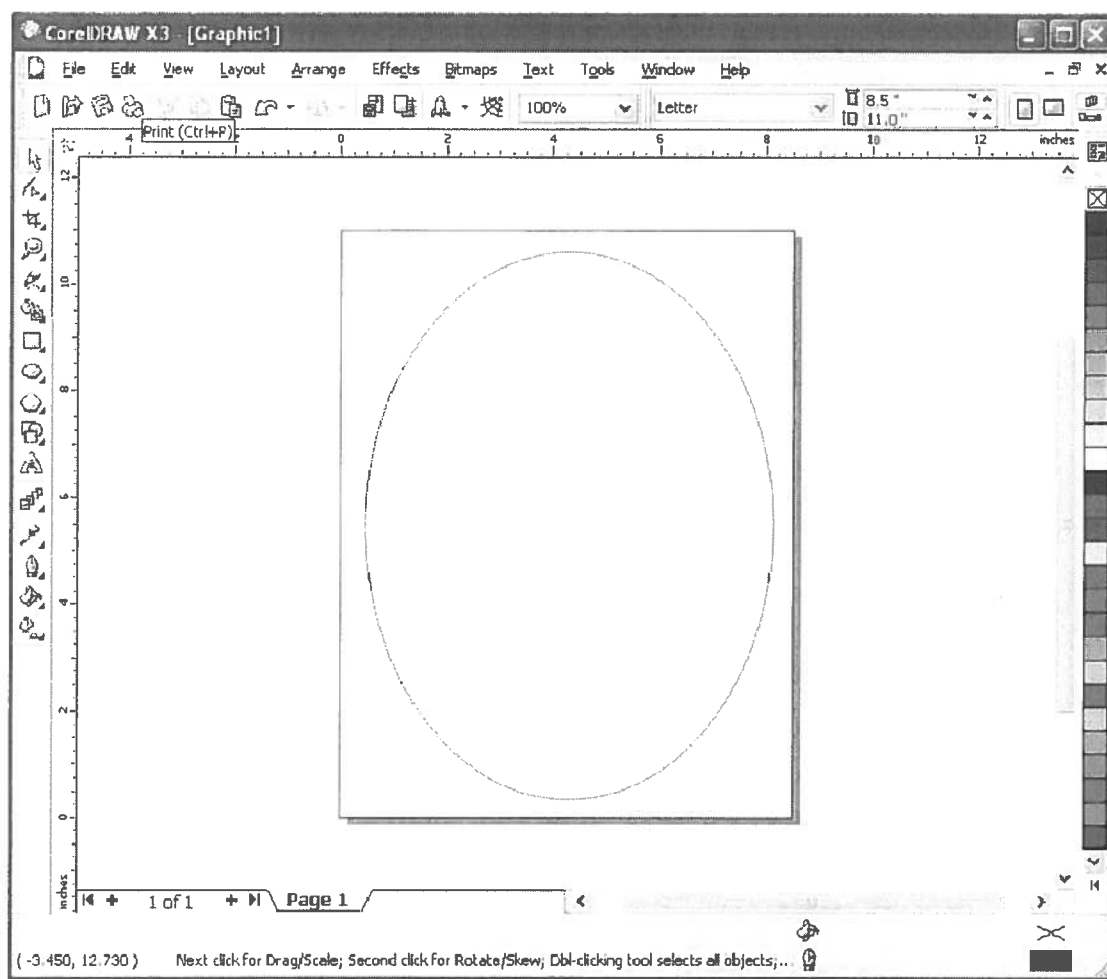
60-Watt LASER CUTTER Speed and Power Recommendations

Material	300 DPI RASTER ENGRAVING	400 DPI RASTER ENGRAVING	600 DPI RASTER ENGRAVING	VECTOR CUTTING
	SPEED/POWER	SPEED/POWER	SPEED/POWER	SPEED/POWER/FREQUENCY
Wood: Cherry, Alder, Walnut	55/90	80/90	100/90	1/8" (3mm) - 35/90/500 1/4" (6.4mm) - 20/90/500 3/8" (9.5mm) - 10/90/500 (two passes may produce better results)
Acrylic	100/50	100/40	100/30	1/8" (3mm) - 20/90/5000 1/4" (6.4mm) - 17/90/5000 3/8" (9.5mm) - 9/90/5000 (two passes may produce better results)
Alumamark	100/30	100/25	100/20	N/A
Anodized Aluminum	100/55	100/45	100/20	N/A
Painted Brass	100/30	100/25	100/20	N/A
Marbelized Painted Brass	100/40	100/35	100/30	N/A
Corian or Avonite	20/90	30/90	40/90	1/8" (3mm) - 50/80/5000
Delrin Seals	100/40	100/30	100/20	60/85/5000
Glass	35/90	45/90	55/90	N/A
Laserable Plastic	100/45	100/35	100/25	30/40/50
Leather	100/40	100/30	100/20	1/8" (3mm) - 60/90/500
Marble	95/90	100/90	100/80	N/A
Mat Board	100/65	100/55	100/45	50/40/500
Melamine	100/60	100/70	100/80	N/A
Stainless Steel W/ Cerdec Coating	N/A	30/90	35/90	N/A
Natural Rubber and Rubber Stamps	15/90	25/90	35/90	20/90/100

CorelDraw Help



The highlighted arrow is the Pick Tool or Selection Tool.
Note also the Outline Tool and Fill Tool.

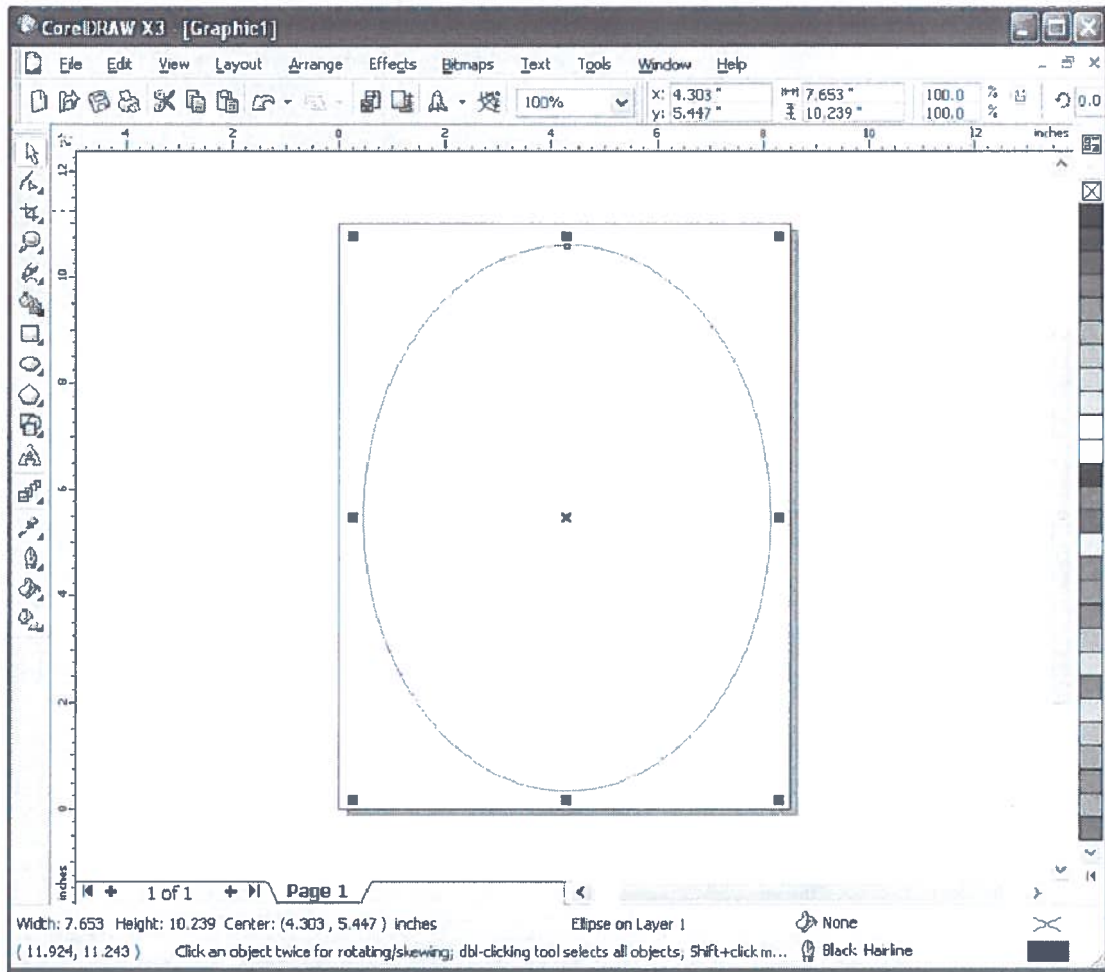


CorelDraw window showing document dimensions

The example above shows a CorelDraw window for a document of the dimensions 8.5" wide by 11.0" tall. To get the document dimensions to appear at the top of the screen as above, use the Pick Tool and click outside all objects so that no objects are selected.



Close up of document dimensions including portrait and landscape indicators



CorelDraw window showing a selected ellipse object

By using the Pick Tool to select an object (an oval in this case), the document dimensions are removed from the window information display but the object dimensions including center x/y and height/width are now displayed.

Note at the bottom right are the Fill Tool and Outline Tool icons. Each indicates the corresponding attributes for the selected object. Use this display to ensure that every object you want to be cut has the characteristic of Hairline.

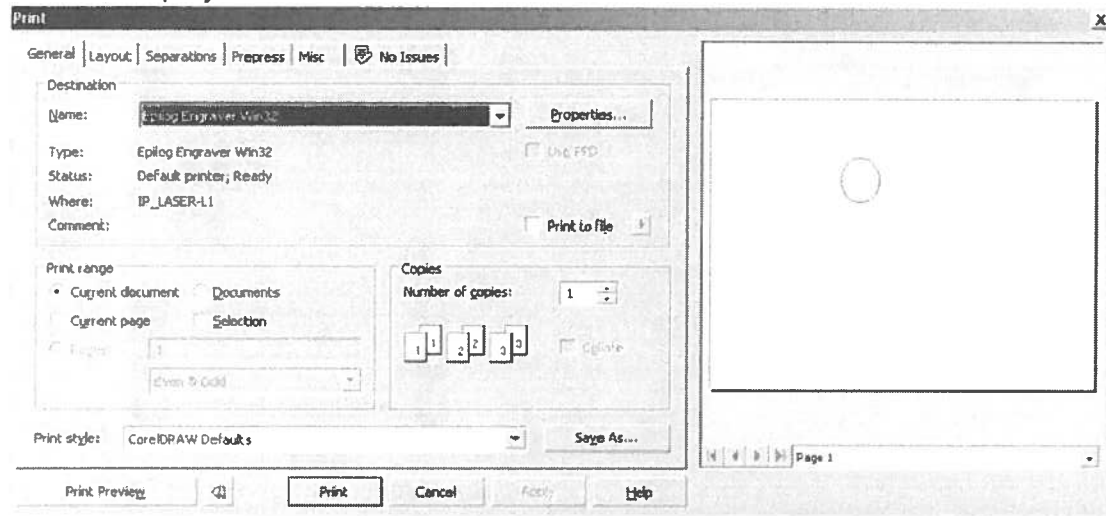


Close-up of object dimensions

Center for x/y is on the left. Width and height are on the right, with icons.

1. From the main menu, choose File → Print.

CorelDraw will display this screen:

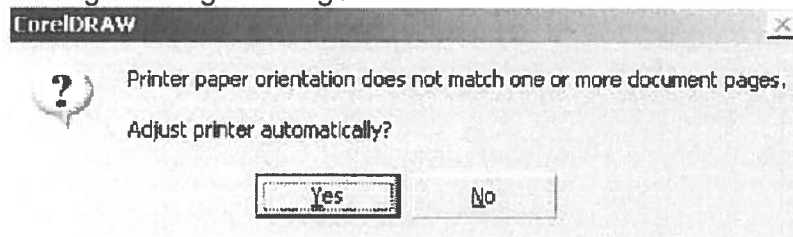


Epilog printer driver screen

2. Click the Properties button.

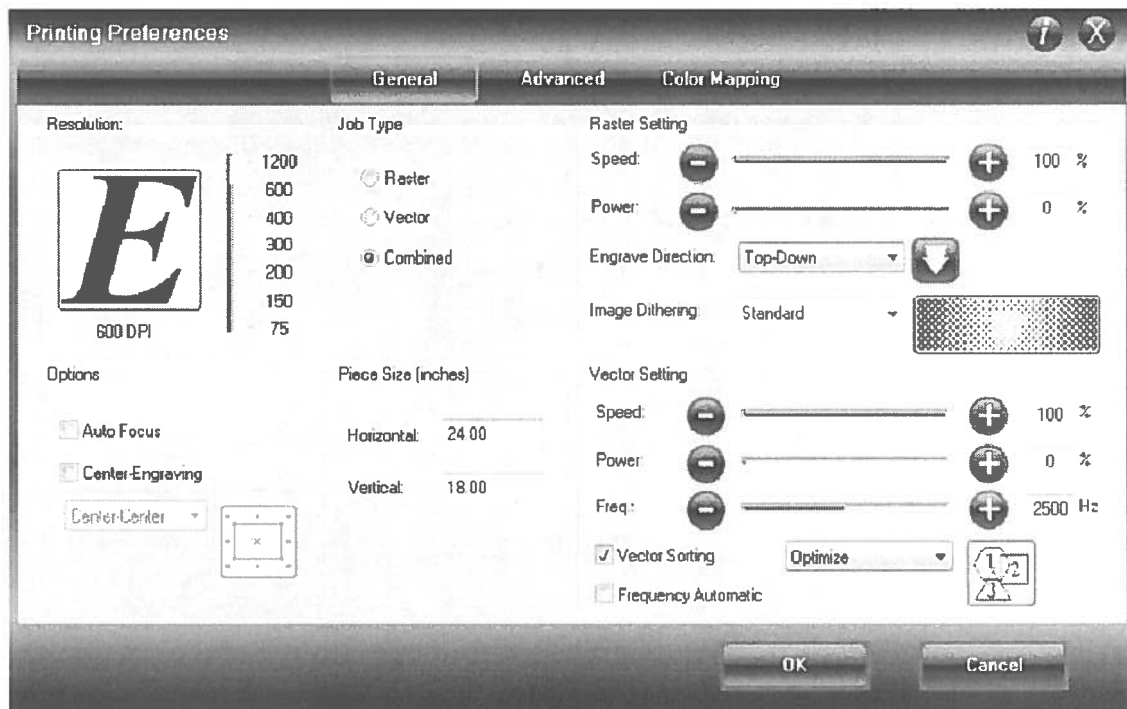
Notice in the preview screen to the right to verify what data will get sent to laser. Data shown will be sent to laser. Data not shown will not be sent.

The Epilog printer driver is expecting a file of size 24" x 18". If your document size is different, you will see the following warning message:



Warning message from Epilog printer driver

3. Click No and set the Piece Size parameters in the Properties window to your document dimensions.

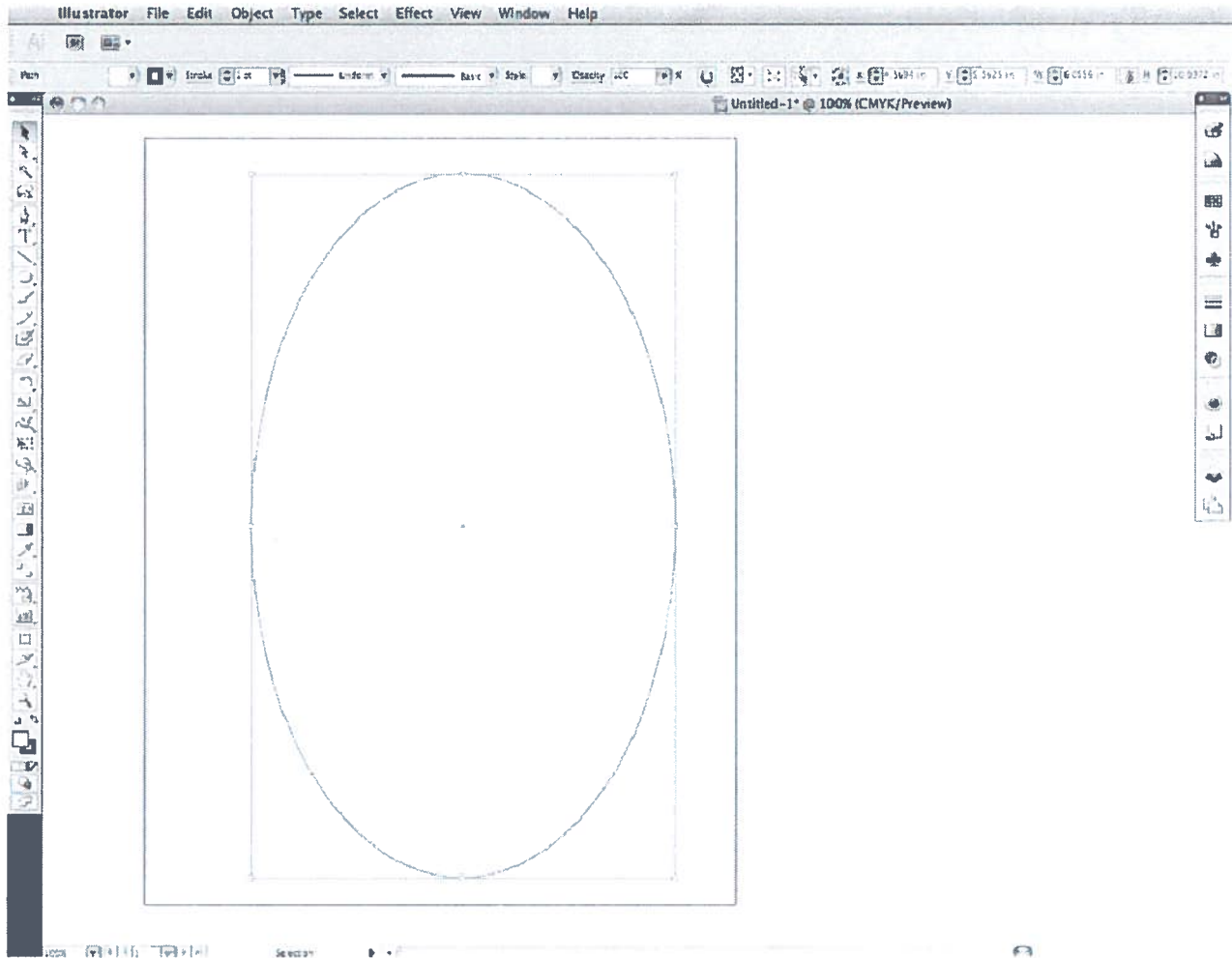


Epilog printer driver parameter window

NOTE: Piece Size defaults to 24.00 x 18.00. Change these setting to your document size. The easiest system is to set your design work area (in CorelDraw or Illustrator) to 24 inches wide and 18 inches tall, and keep the printer settings piece size at its default of 24 x 18.



Laser Cutting and Etching Safety and Basic Use



Adobe Illustrator window showing image dimensions

The example above shows an Adobe Illustrator window for an image of the dimensions 6.0556" wide by 10.0972" tall. To get the document dimensions to appear at the top of the screen as above, use the Selection Tool and click outside all objects so that no objects are selected.



Close up of document dimensions

By using the Selection Tool to select an object (an oval in this case), the document dimensions are removed from the window information display but the object dimensions including center x/y and height/width are now displayed.

Note at the bottom right are the Fill Tool and Outline Tool icons. Each indicates the corresponding attributes for the selected object. Use this display to ensure that every object you want to be cut has the characteristic of Hairline.

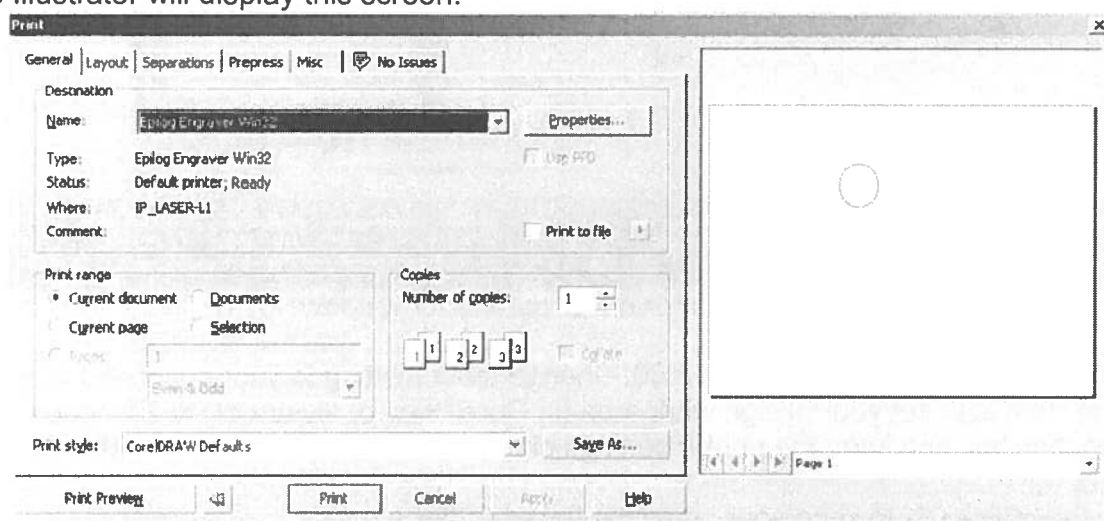


Close-up of object dimensions

Center for x/y is on the left. Width and height are on the right, with icons.

1. From the main menu, choose File → Print.

Adobe Illustrator will display this screen:

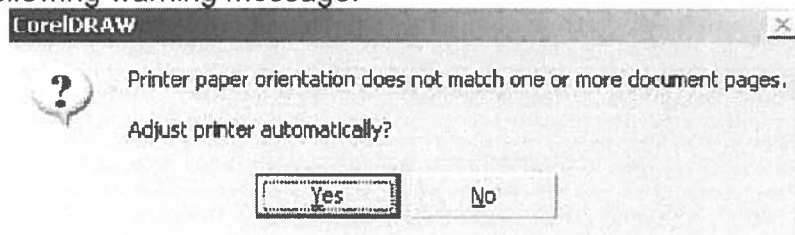


Epilog printer driver screen

2. Click the Properties button.

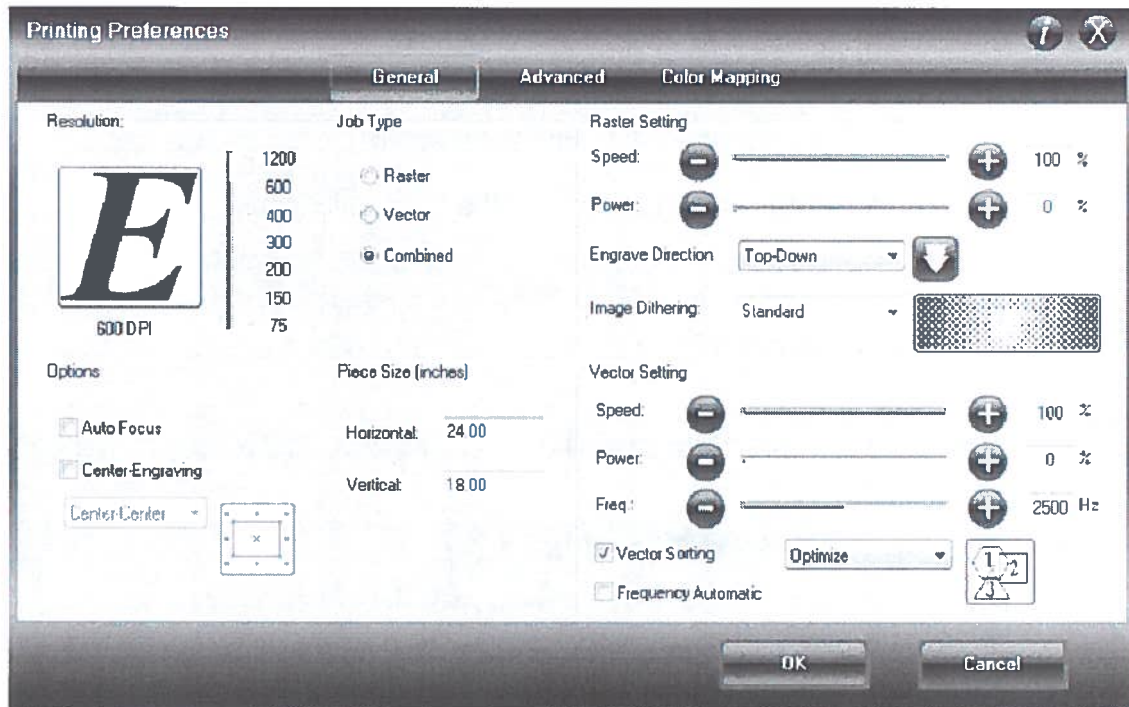
Notice in the preview screen to the right to verify what data will get sent to laser. Data shown will be sent to laser. Data not shown will not be sent.

The Epilog printer driver is expecting a file of size 24" x 18". If your document size is different, you will see the following warning message:



Warning message from Epilog printer driver

3. Click No and set the Piece Size parameters in the Properties window, General Tab to your document dimensions.



Epilog printer driver parameter window

Note: Piece Size defaults to 24.00 x 18.00. Change these setting to your document size. The easiest system is to set your design work area (in CorelDraw or Illustrator) to 24 inches wide and 18 inches tall, and keep the printer settings piece size at its default of 24 x 18.

4. Click OK to send your job to the Laser Cutter.
5. Press the Go button on the Laser Cutter to start the job printing.

Additional Resources

Adobe Illustrator Raster to Vector Conversion: LIVE TRACE Instructions for use with the Laser Cutter

1. Launch AI and choose FILE → NEW
2. Choose FILE → PLACE → Browse to find the desired .jpg file
3. Use the SELECTION TOOL (solid arrow) and click on the object to select the whole object.
4. From the OBJECT menu → LIVE TRACE → TRACING OPTIONS
 - a. Fill uncheck this
 - b. Stroke check this
5. Click TRACE.
6. From the OBJECT menu → LIVE → LIVE TRACE → EXPAND (this is what actually finished the Live Trace process with real lines.)
7. Use the Zoom tool to zoom in and check for gaps in the line. (Hold Alt and click to zoom out)
8. Use the DIRECT SELECTION TOOL (hollow arrow) to move individual points or to select them to join them:
 - a. From the OBJECT menu → PATH → JOIN (or ctrl J)
9. From the EDIT menu → SELECT ALL (ctrl A) → STROKE → WEIGHT → .25
10. From the FILE menu → SAVE AS
 - a. Type: ADOBE ILLUSTRATOR
 - b. ILLUSTRATOR OPTIONS
 - i. VERSION: ILLUSTRATOR 3

Fonts to Outlines for the Cutting on the Laser

1. Type the text you want to create an outline of.
2. Using the SELECTION TOOL (solid arrow) click to select the text.
3. Choose TYPE → CREATE OUTLINES.
4. Change the Fill to NONE; change the Stroke to BLACK and the Stroke width to .25

Clean-Up

- Vacuum under the wire mesh table to remove small parts that may have fallen through the mesh. On some machines there is a removable tray under the print tray, which you can slide through the front access door. Turn the machine off when you vacuum.
- Check the lens: This lens is NOT User cleanable - If the lens is dirty, alert the Front Desk or TechShop staff so they may clean it.

Questions:

- Given all other things equal, if you increase DPI, what effect will that have on your vector art? What changes might this make you consider for your vector art?
- Given all other things equal, if you increase DPI, what effect will that have on your raster art? What changes might this make you consider for your raster art?
- Power setting can range from 0% to 100%. What is the lowest heat setting you could choose for Power?
- Speed setting can range from 1% to 100%. What is the lowest heat setting you could choose for Speed?
- Does it make sense to use the same parameter settings on the 60 watt lasers as on the 45 watt lasers?

COOL LINKS

www.EpilogLaser.com/tech_library.htm has great technical info and projects for use with the Epilog Laser.

www.epiloglaser.com/sample_club.htm has great projects for the laser Cutter.

www.laserbits.com offers laser specific materials for etching and cutting.

www.instructables.com offers many projects that would be suitable for the laser cutter.

Check out the TechShop store for cool anodized aluminum items, like luggage tags, golf divot tools, license plates, and much more!

WHAT'S NEXT?

After successfully completing this **LAS101 Laser Cutting and Etching SBU**, you might be interested in these classes:

- LAS201 Laser Engraver Rotary Attachment SBU
- WLD104 CNC Plasma Cutter SBU
- FAB107 Sand Blasting and Powder Coating SBU

